

PRELIMINARY

TECHNICAL INFORMATION REPORT

FOR

TIBBETT'S CROSSING

CITY OF ISSAQUAH IN KING COUNTY, WASHINGTON



9/19/18

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Tibbett's Crossing

Table of Contents

1 PROJECT OVERVIEW	1
Figure 1-1: Vicinity Map	2
2 CONDITIONS AND REQUIREMENTS SUMMARY	3
2.1 Core Requirements	3
2.1.1 Core Requirement #1: Discharge at the Natural Location.....	3
2.1.2 Core Requirement #2: Offsite Analysis.....	3
2.1.3 Core Requirement #3: Flow Control	3
2.1.4 Core Requirement #4: Conveyance System	3
2.1.5 Core Requirements #5: Erosion and Sediment Control.....	3
2.1.6 Core Requirement #6: Maintenance and Operations	3
2.1.7 Core Requirement #7: Financial Guarantees and Liability	3
2.1.8 Core Requirement #8: Water Quality.....	3
2.2 Special Requirement #1: Other Adopted Area-Specific Requirements	3
2.2.1 Critical Drainage Areas.....	3
2.2.2 Master Drainage Plan	3
2.2.3 Basin Plans	4
2.2.4 Salmon Conservation Plans (SCPs).....	4
2.2.5 Stormwater Compliance Plans (SWCPs)	4
2.2.6 Lake Management Plans (LMPs).....	4
2.2.7 Flood Hazard Reduction Plan Updates (FHRPs).....	4
2.2.8 Shared Facility Drainage Plans (SFDPs).....	4
2.3 Special Requirement #2: Floodplain / Floodway Delineation.....	4
2.4 Special Requirement #3: Flood Protection Facilities	4
2.5 Special Requirement #4: Source Controls.....	4
2.6 Special Requirement #5: Oil Control.....	4
3 OFFSITE ANALYSIS.....	5
TASK 1 Study Area Definition and Maps	5
TASK 2 Resource Review	5

TASK 3 Field Investigation	5
Figure 3-1: Downstream Drainage Exhibit.....	9
TASK 4 Drainage System Description and Problem Description	10
TASK 5 Mitigation of Existing and Potential Problems.....	10
Figure 3-4: Current Water Quality Conditions (Temperature Levels)	12
4 FLOW CONTROL AND WATER QUALITY DESIGN	15
4.1 Existing Site Hydrology	15
4.2 Developed Site Hydrology	17
4.3 Performance Standards.....	17
Figure 4-1: Existing Conditions Basin Exhibit.....	19
4.4 Flow Control System	21
Figure 4-2: Developed Conditions Exhibit	23
4.5 Water Quality Calculations	28
5 CONVEYANCE SYSTEM ANALYSIS AND DESIGN	31
6 SPECIAL REPORTS AND STUDIES.....	33
7 OTHER PERMITS.....	35
8 ESC ANALYSIS AND DESIGN	37
9 BOND QUANTITIES, FACILITY SUMMARIES, AND DECLARATION OF COVENANT	39
9.1 Bond Quantities	39
9.2 Facility Summaries	39
9.3 Declaration of Covenant	39
10 OPERATIONS AND MAINTENANCE	41

Appendix A – Parcel & Basin Information

King County Parcel Report

Figure 2-2 Stormwater Drainage Sub-basins in Issaquah

Appendix B – Resource Review & Off-site Analysis Documentation

Critical Aquifer Recharge Area Classification Map

FEMA Map (53033C0693G)

USDA NRCS Site Soils Report

Drainage Complaints Exhibit

Appendix C – Vault Sizing

West Vault Summary

East Vault Summary

Peaks Performance Plot

Durations Performance Plot

1 PROJECT OVERVIEW

The project site is located at 7932 Renton-Issaquah Road SE in the City of Issaquah, King County. Specifically, the project is located partially in the southeast quarter of Section 29, Township 24 North, Range 6 East, W.M. and partially in the northeast quarter of Section 32, Township 24 North, Range 6 East, W.M. The site is bordered by single-family residences and a nursery to the north, a parcel owned by King County to the east and additional single-family residences to the east and south. The west property line is bordered by Renton-Issaquah Road SE and a single-family residence on the south half of the site. The King County tax parcel ID number is shown in Table 1 below (refer to the King County Parcel Reports included in Appendix A).

Table 1: Parcel Information		
KC Parcel #	Parcel Area (SF)	Parcel Area (ac)
2924069041	955,902	21.9

The total parcel area is approximately 21.9 acres in size and forested on the east half of the site with a single-family residence and lawn covering the west half of the site. Tibbett's Creek occupies the west property line for approximately 300 feet, before continuing north through the center of the site. The project area drains towards the center of the site where Tibbett's Creek collects the runoff and flows north, exiting the site near the center of the north property line. The entire project site is tributary to Tibbett's Creek, eventually discharging into Lake Sammamish. Minimal upstream drainage will flow on to the site from the single-family residence east of the project site.

The proposed development includes 20 lots, two detention vaults, dispersion and infiltration BMPs, buffer averaging and the associated roads and utilities. BMP design is described in detail in Section 4 of this report. Critical areas include wetlands, steep slopes and Tibbett's Creek. See *Figure 1-1: Vicinity Map*, provided below.

The project will be designed using the guidelines and requirements established in the 2009 King County Surface Water Design Manual (2009 KCSWDM) and City of Issaquah Addendum criteria. The project will be adding more than 5,000 square feet of new impervious area so it is required to apply Conservation Flow Control (Level 2) and Sensitive Lake Water Quality.

The detention vaults have been modeled using the King County Runoff Time Series (KCRTS) software.

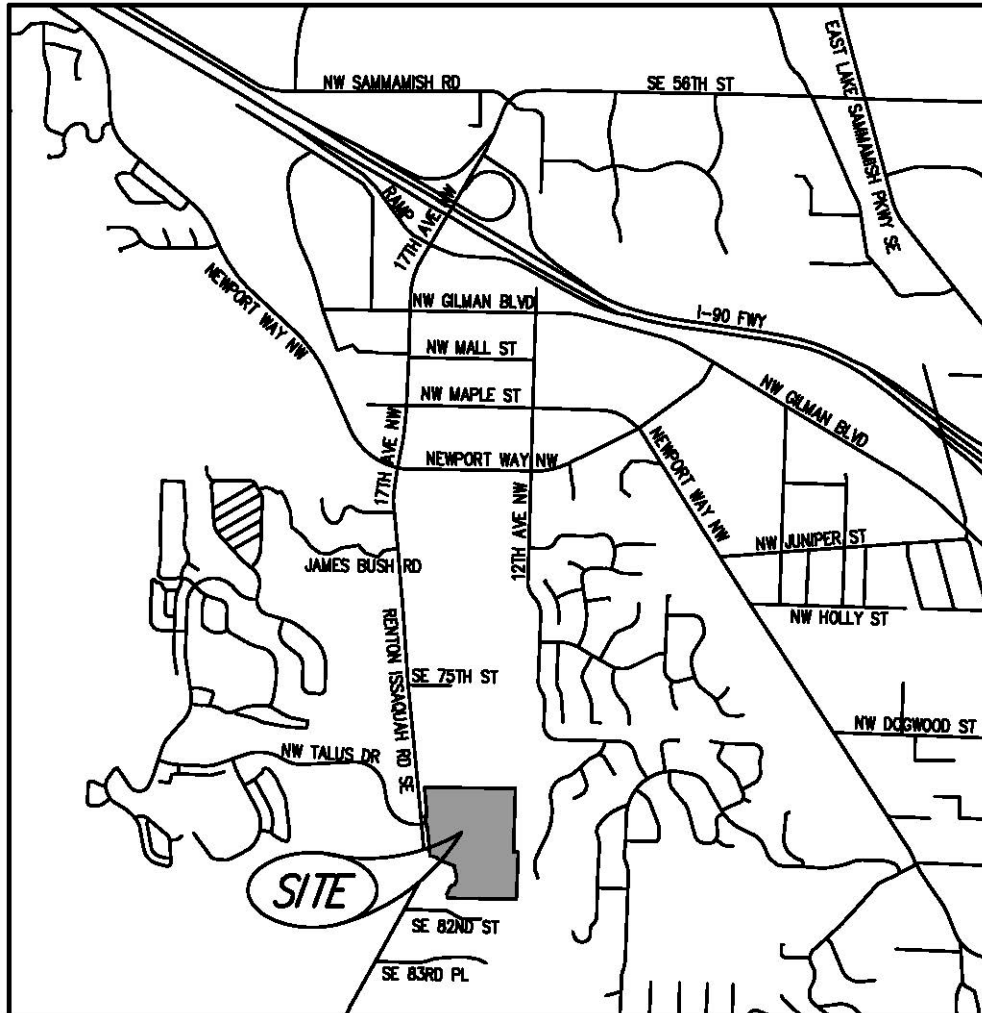


Figure 1-1: Vicinity Map

2 CONDITIONS AND REQUIREMENTS SUMMARY

The proposed project is classified as requiring “Full Drainage Review” per the 2009 KCSWDM. Therefore, all eight core requirements and five special requirements will be addressed per Section 1.1 of the 2009 KCSWDM.

2.1 Core Requirements

2.1.1 Core Requirement #1: Discharge at the Natural Location

This project will match the natural discharge point of Tibbett’s Creek at the north property line.

2.1.2 Core Requirement #2: Offsite Analysis

An offsite analysis has been completed for the project site. This core requirement is addressed in Section 3 of this report.

2.1.3 Core Requirement #3: Flow Control

The detention vaults are designed for Conservation Flow Control (Level 2). This requires that the developed condition discharge durations match the existing condition durations from 50% of the 2-year to the 50-year storm events and that the developed 2-year and 10-year peak discharge rates do not exceed the existing 2-year and 10-year peak discharge rates, respectively.

2.1.4 Core Requirement #4: Conveyance System

Conveyance and backwater analysis calculations will be completed during final engineering. The proposed conveyance system will provide sufficient capacity for the 25-year storm as calculated by the Rational Method.

2.1.5 Core Requirements #5: Erosion and Sediment Control

Erosion and sediment control design will be provided during the Site Work Permit.

2.1.6 Core Requirement #6: Maintenance and Operations

The detention vaults and stormwater BMPs will be privately maintained.

2.1.7 Core Requirement #7: Financial Guarantees and Liability

A bond quantities worksheet will be provided in Section 9 of this Report during final engineering.

2.1.8 Core Requirement #8: Water Quality

Lake Sammamish is listed as a Sensitive Lake, therefore the project is subject to the Sensitive Lake Protection menu for water quality. Water quality design is discussed in Section 4 of this report.

2.2 Special Requirement #1: Other Adopted Area-Specific Requirements

2.2.1 Critical Drainage Areas

Per the City’s Critical Aquifer Recharge Areas map (included in Appendix B) the site is not located within a Critical Aquifer Recharge Area.

2.2.2 Master Drainage Plan

Not applicable.

2.2.3 Basin Plans

The project site is located within the Issaquah Creek Basin Plan. The entire site is tributary to the Tibbett's Creek Subbasin, which drains to Lake Sammamish.

2.2.4 Salmon Conservation Plans (SCPs)

Not applicable.

2.2.5 Stormwater Compliance Plans (SWCPs)

Not applicable.

2.2.6 Lake Management Plans (LMPs)

Not applicable.

2.2.7 Flood Hazard Reduction Plan Updates (FHRPs)

A Flood Hazard Reduction Plan is not applicable to the project site.

2.2.8 Shared Facility Drainage Plans (SFDPs)

Not applicable.

2.3 Special Requirement #2: Floodplain / Floodway Delineation

Tibbett's Creek, containing a 100-year floodplain, crosses through the project site (see FEMA Map included in Appendix B). The floodplain will be delineated on the engineering plans.

2.4 Special Requirement #3: Flood Protection Facilities

The project site contains a 100-year floodplain, however the floodplain lies outside the areas proposed for development. Refer to the FEMA Map included in Appendix B.

2.5 Special Requirement #4: Source Controls

This project does not require a commercial building or commercial site development permit so source controls do not apply.

2.6 Special Requirement #5: Oil Control

This project is not considered a high use site so oil control does not apply.

3 OFFSITE ANALYSIS

TASK 1 Study Area Definition and Maps

The proposed project contains parcel number 2924069041.

TASK 2 Resource Review

Basin Reconnaissance Summary Reports

No Basin Reconnaissance Summary Reports appear to be available for the area that is within one mile of this project site.

FEMA Maps

A FEMA map dated April 19, 2005 number 53033C0693G was reviewed. Tibbett's Creek, containing a 100 year floodplain, crosses through the project site. The FEMA Map is included in Appendix B.

Sensitive Areas Folio

The project site has steep slopes, a creek and wetlands on site.

USDA Natural Resources Conservation Service Soil Survey

The USDA Natural Resources Conservation Service (NRCS) Web Soil Survey covers the project site area and states that the area of interest comprises of mainly of Kitsap Silt Loam, with smaller areas of Everett very gravelly sandy loam and mixed alluvial sand. The Soils Map exhibit is included in Appendix B.

Downstream Drainage Complaints

Drainage complaints were researched within 1 mile downstream of the study area. King County lists three complaints located within a one-mile radius downstream of the project site. According to the 2009 KCSWDM, drainage complaints that are over 10 years old are not required for a level 1 downstream analysis. All three complaints were made over 10 years ago, therefore a review of these complaints is not required.

There are no current documented downstream problems associated with this project site. See *Drainage Complaint Exhibit* in Appendix B.

TASK 3 Field Investigation

Upstream Tributary Area

A negligible amount of upstream drainage enters the site from the single family residences immediately east of the property. Any upstream drainage is tributary to Tibbett's creek running through the center of the site and exiting the site at the north property line

Level 1 Downstream Analysis

The field investigation was completed on September 6, 2018. The weather was sunny and the temperature was approximately 75 degrees. See Downstream Drainage Exhibit at the end of this section.

The site currently consists of several dilapidated wood structures and an abandoned single family house. Area west of Tibbetts Creek is covered in pasture with clusters of trees scattered throughout, sloping east towards Tibbetts Creek. The area surrounding the creek is forested and with overgrown blackberry bushes. Area on site east of Tibbetts Creek is entirely forested, sloping to the west with slopes up to 25%. A wetland exists at the northwest corner of the site.

Runoff on site currently sheet flows towards the center of the site, where Tibbetts Creek flows from the south property line to the north property line and exits the property, continuing north. All area on site is tributary to Tibbetts Creek. Runoff exits the site at the north property line where it continues in a northerly direction for approximately 500 feet before entering a bridge culvert about 6 feet wide and travels under a driveway on the property to the north. The creek then continues north through several single family properties before reaching a point $\frac{1}{4}$ mile downstream, where the analysis is terminated.

The condition of Tibbetts Creek was evaluated at several points along the downstream path. The creek ranges from 5-8 feet in width on average and up to 6 inches in depth, with no signs of erosion or significant sedimentation observed. The downstream system appears, in general, to be stable.

The following pages show photos of the downstream path. See Figure 3-1 Downstream Drainage Exhibit following this analysis for location of photos and location of points referenced in the report.



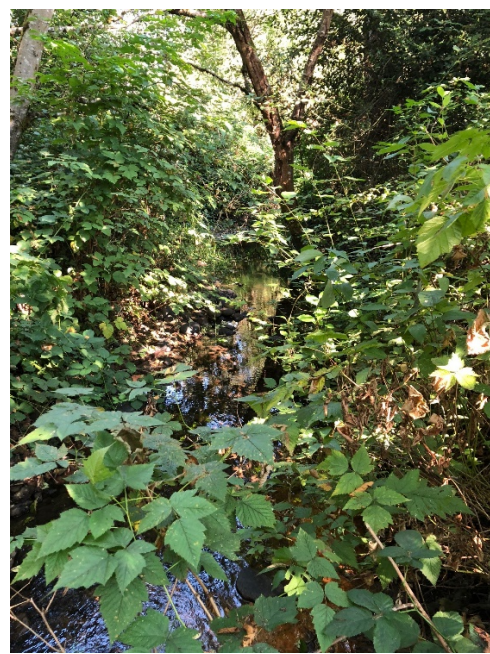
1 – On site looking south, upstream Tibbett's Creek.



2 – Tibbett's Creek on site looking north.



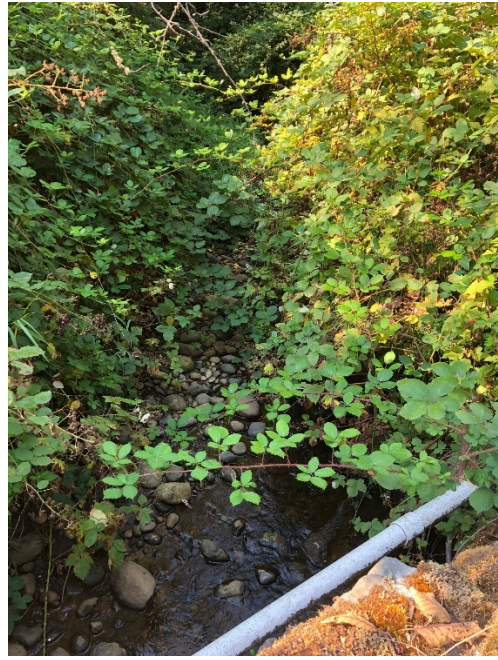
3 – Location 2 on map. Downstream of site looking south.



4 – Location 2. 300 feet downstream of site looking north.



5 – Location 3 looking north of downstream culvert.

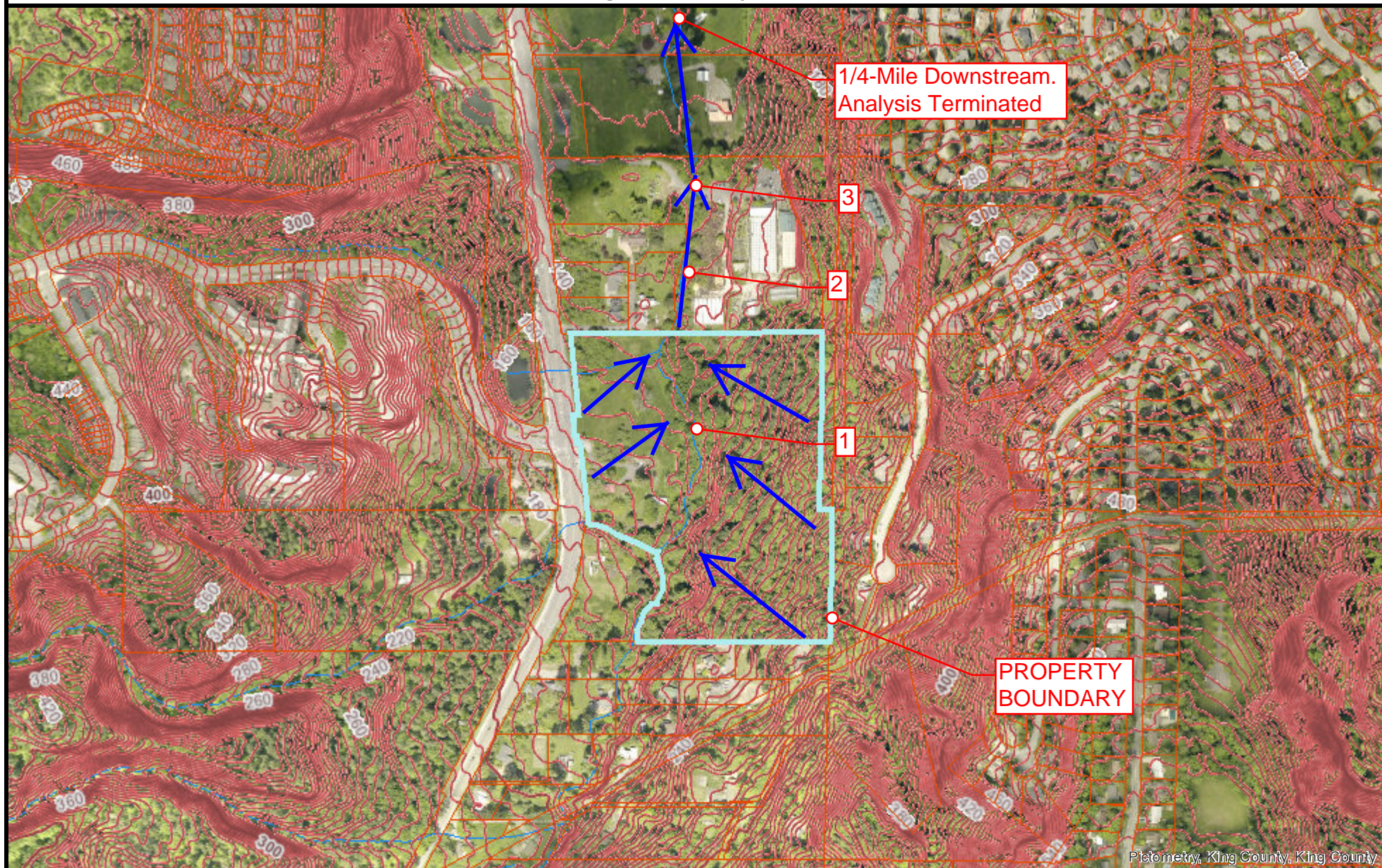


6 – Location 3 looking south of downstream culvert.



7 – Looking south through downstream culvert, approximately 500 feet downstream of site to north.

King County iMap



Pictometry, King County, King County

The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.

Date: 9/4/2018

Notes:



 **King County**
GIS CENTER

TASK 4 Drainage System Description and Problem Description

A description of the existing drainage system has been included in the downstream analysis and all drainage system components can be seen in Figure 3-1: Downstream Drainage Exhibit.

TASK 5 Mitigation of Existing and Potential Problems

Downstream Drainage Problems Requiring Special Attention

Type 1 – Conveyance System Nuisance Problems

There are no known, reported or observed current downstream conveyance nuisance problems.

Type 2 – Severe Erosion Problems

There are no known, reported or observed current downstream severe erosion problems

Type 3-Severe Flooding Problems

There are no known, reported or observed current downstream severe flooding problems.

Downstream Water Quality Problems Requiring Special Attention

The City of Issaquah Surface Water Design Manual Addendum, the current (2012) EPA approved Water Quality Assessment (303d) list for Washington State and the 2009 KCSWDM Reference 10, King County-Identified Water Quality Problems were reviewed for each of the seven downstream water quality problem types to a distance of one mile downstream of the project site. The following discussion includes reference to the updated (2012) 303(d) list of impaired water bodies.

Type 1 – Bacteria Problems

There are no known or reported downstream bacteria problems.

Type 2 – Dissolved Oxygen (DO) Problems

Tibbett's Creek is listed as a Category 5 on the impaired water body list for dissolved oxygen.

Figure 3-3: Current Water Quality Conditions (Dissolved Oxygen Levels)

Listing ID: 15778	
Main Listing Information	
Listing ID: 15778	2014 Category: 5
Waterbody Name: TIBBETTS CREEK	2012 Category: 5
Medium: Water	2008 Category: 5
Parameter: Dissolved Oxygen	2004 Category: 5
WQI Project: None Assigned	On 1998 303(d) List?: N
Designated Use: None Assigned	On 1996 303(d) List?: N
Assessment Unit	
Assessment Unit ID: 17110012000224	
Location Identification	
Counties: King	WRIA: 8 - Cedar-Sammamish
Waterbody ID (WBID): WA-08-1115	Waterbody Class: RAA
Town/Range/Section (Legacy): 24N-6E-29	
Basis	
King County unpublished data from station A630 (Tibbetts Creek RM 1.0) show the criterion was exceeded in 1987, 1988, 1989, and 1990.	
Remarks	
No Remarks Entered	
EIM	
No EIM Records Entered	

Type 3 – Temperature Problems

Tibbett's Creek is listed as a Category 5 on the impaired water body list for temperature.

Figure 3-4: Current Water Quality Conditions (Temperature Levels)

Listing ID: 15781	
Main Listing Information	
Listing ID: 15781	2014 Category: 5
Waterbody Name: TIBBETTS CREEK	2012 Category: 5
Medium: Water	2008 Category: 5
Parameter: Temperature	2004 Category: 5
WQI Project: None Assigned	On 1998 303(d) List?: N
Designated Use: None Assigned	On 1996 303(d) List?: Y
Assessment Unit	
Assessment Unit ID: 17110012000224	
Location Identification	
Counties: King	WRIA: 8 - Cedar-Sammamish
Waterbody ID (WBID): WA-08-1115 Waterbody Class: RAA	
Town/Range/Section (Legacy): 24N-6E-29	
Basis	
U.S.Geological Survey data from NWIS database station 12121699 (Tibbetts Cr at SE Newport Way nr Issaquah) shows 1 excursions beyond the criterion out of 1 samples collected between 01/93 - 10/00.	
King County unpublished data from station A630 (Tibbetts Creek RM 1.0) show the criterion was exceeded in 1987, 1988, 1989, and 1990.between 1/91 and 4/97.	
Remarks	
No Remarks Entered	
EIM	
No EIM Records Entered	

Type 4 – Metals Problems

There are no known or reported downstream metals problems.

Type 5 – Phosphorous Problems

There are no known or reported downstream phosphorous problems.

Type 6 – Turbidity Problems

There are no known or reported downstream turbidity problems.

Type 7 – High pH Problems

There are no known or reported downstream turbidity problems.

Other

Tibbett's Creek is listed as a Category 5 for bioassessment.

Listing ID: 70112			
Main Listing Information			
Listing ID: 70112	2014 Category: 5		
Waterbody Name: TIBBETTS CREEK	2012 Category: 3		
Medium: Other	2008 Category: 3		
Parameter: Bioassessment	2004 Category: 3		
WQI Project: None Assigned	On 1998 303(d) List?: N		
Designated Use: None Assigned	On 1996 303(d) List?: N		
Assessment Unit			
Assessment Unit ID: 17110012000224			
Location Identification			
Counties: King		WRIA: 8 - Cedar-Sammamish	
Waterbody ID (WBID): None Assigned		Waterbody Class: None Assigned	
Town/Range/Section (Legacy): 24N-6E-20			
Basis			
Location ID [08LAK3616] was sampled by King County - the Benthic Index of Biotic Integrity (B-IBI) score was 26 in 2006, 20 in 2007, 20 in 2008, 18 in 2010;			
Location ID [08LAK3699] was sampled by King County - the Benthic Index of Biotic Integrity (B-IBI) score was 26 in 2006, 20 in 2007, 16 in 2008, 18 in 2009, 30 in 2010			
Remarks			
Remark	Modified By	Modified On	Visibility
The source of the benthic macroinvertebrate community data and associated B-IBI scores is the Puget Sound Stream Benthos database, which is maintained by King County.	Patrick Lizon	12/22/2015	Private
The listing has been reassessed under the current Policy 1-11 and has been moved from Category 3 to Category 5 based on new data.	Curtis Cooper	8/13/2015	Private
The listing has been placed in Category 5 because the two most recent data points indicate that biological integrity is degraded or because two or more B-IBI/RIVPACS data points in the most recent five data points indicate biological degradation and the scores do not qualify for Category 1 or Category 2. A B-IBI score ≤ 27 and a RIVPACS score less than 0.73 indicates degraded biological integrity. A data point is the lowest bioassessment score observed for a given year.	Curtis Cooper	8/13/2015	Public
EIM			
No EIM Records Entered			

Drainage Adjustments

There is no drainage adjustment proposed for this project.

4 FLOW CONTROL AND WATER QUALITY DESIGN

4.1 Existing Site Hydrology

The total site area for the plat including the critical areas is 21.94 acres, however the total developable area is 16.47 acres. The existing parcel is forested on the east half, with a single family residence, grass, and scattered trees on the west half. The site contains slopes up to 25% on the east half and average slopes of 5-10% on the west half. The entire site slopes towards the center where Tibbett's Creek exists and is flowing to the north, exiting the site at the north property line. A wetland also exists near the center of the site associated with Tibbett's Creek, with an additional wetland at the northwest corner of the project site. A geotechnical investigation of the project site has been completed by Associated Earth Sciences, Inc. and is included in Appendix B of this report.

As stated above, the entire site slopes towards the center, thus the entire site area is tributary to Tibbett's Creek. The site has been delineated further into two subbasins, one for the area west of Tibbett's Creek, and one subbasin for the area east of Tibbett's Creek.

See Table 4-1 below and *Figure 4-1: Existing Conditions* provided in the following pages of this section. Existing site conditions (forested) are assumed for all predeveloped areas. The predeveloped areas were determined based on historic conditions of the site including existing impervious area and are excluding all critical areas and area not affected by development. This assumption is based on Section 1.1.3 of the Issaquah Surface Water Design Manual Addendum which says projects proposing more than 5,000 sf of new impervious surface shall assume historic conditions except for existing impervious surfaces for the pre-developed condition. Area shown for the east basin is tributary to the east vault while area shown for the west basin is tributary to the west vault.

Table 4-1 Predeveloped Areas			
GROUND COVER	EAST AREA (acres)	WEST AREA (acres)	TOTAL (acres)
Till-Forest	0.32	2.34	2.66
Impervious	0.00	0.32	0.32
TOTAL	0.32	2.66	2.98

The peak flow rates for the pre-developed conditions of each basin as determined by KCRTS (one hour time steps) are shown below. A regional scale factor of LA 1.1 was used as determined by Figure 3.2.2.A.

Flow Frequency Analysis
Time Series File:predev_east.tsf
Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-----			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.032	2	2/09/01 18:00	0.038	1	100.00	0.990
0.005	7	1/05/02 16:00	0.032	2	25.00	0.960
0.021	4	2/28/03 16:00	0.027	3	10.00	0.900
0.004	8	3/03/04 5:00	0.021	4	5.00	0.800
0.019	5	1/05/05 10:00	0.019	5	3.00	0.667
0.015	6	1/18/06 21:00	0.015	6	2.00	0.500
0.027	3	11/24/06 5:00	0.005	7	1.30	0.231
0.038	1	1/09/08 7:00	0.004	8	1.10	0.091
Computed Peaks			0.036		50.00	0.980

Flow Frequency Analysis
Time Series File:predev_west.tsf
Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-----			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.269	2	2/09/01 18:00	0.319	1	100.00	0.990
0.044	7	1/05/02 16:00	0.269	2	25.00	0.960
0.172	4	2/28/03 16:00	0.219	3	10.00	0.900
0.031	8	3/03/04 2:00	0.172	4	5.00	0.800
0.157	5	1/05/05 10:00	0.157	5	3.00	0.667
0.126	6	1/18/06 21:00	0.126	6	2.00	0.500
0.219	3	11/24/06 5:00	0.044	7	1.30	0.231
0.319	1	1/09/08 7:00	0.031	8	1.10	0.091
Computed Peaks			0.303		50.00	0.980

4.2 Developed Site Hydrology

This project includes 20 lots with associated roads and utilities, and two combined detention and water quality vaults. As previously stated, the project site has been delineated into two subbasins, one for the developed area west of Tibbett's Creek and another for developed area east of the creek. A detention vault will collect and treat stormwater for each subbasin in order to meet flow control and water quality requirements. The detention vault for the east basin will be located under the roadway on the east side of the bridge that spans Tibbett's Creek. Stormwater runoff from the roadway east of the creek and some roadway from the west side of the creek will be tributary to this vault. Runoff from Lots 1-16 and the rest of the roadway will be tributary to the west vault located north of Lot 14. Each detention vault will then discharge into Tibbett's Creek, preserving the natural discharge location of the site.

When modeling the detention vaults, only areas tributary to the detention facilities will be accounted for, including all impervious areas and landscaping. Critical areas such as Tibbett's Creek, wetlands, and all associated buffers are not included in the areas used for sizing the detention facilities. Lots 17-20 have been mitigated for flow control using full infiltration and full dispersion BMPs and have therefore been excluded from the areas used for modeling. In addition, 0.04 acres of roadway directly above Tibbett's Creek will be modeled as bypass as it cannot be directed to a flow control facility. The areas input to KCRTS for modeling of the detention facilities are summarized in Table 4-2 below. These areas also include modeling credits earned from the use of Flow Control BMPs. Design of the flow control BMPs and the applicable credits are discussed further in Section 4.4 of this report.

Table 4-2 Developed Condition Areas			
GROUND COVER	EAST AREA (acres)	WEST AREA (acres)	TOTAL (acres)
Till-Forest	0.00	0.56	0.56
Till-Grass	0.01	0.37	0.38
Outwash- Forest	0.00	0.04	0.04
Outwash- Grass	0.00	1.02	1.02
Effective Impervious	0.27	0.67	0.94
Bypass (Impervious)	0.04	0.00	0.04
TOTAL DEVELOPED AREA	0.32	2.66	2.98

4.3 Performance Standards

All stormwater facilities will be designed in accordance with the 2009 KCSWDM with the City of Issaquah Surface Water Design Manual Addendum, Attachment B, dated October 31, 2011, with Conservation Flow Control Standards. The proposed water quality treatment system will meet requirements from the Sensitive Lake Water Quality Protection Menu.

Flow Control: Conservation Flow Control Standard

The Conservation Flow Control Standard requires maintaining the durations of high flows at their pre-development levels for all flows greater than one-half of the 2-year peak flow through the 50-year peak flow. The pre-development peak flow rates for the 2-year and 10-year runoff events must also be maintained under this requirement.

Conveyance Capacity:

The proposed conveyance system will be designed with sufficient capacity to convey and contain the 25-year peak flow as determined by the Rational Method. It will also be verified that the 100-year peak flow will not create or aggravate a severe flooding or erosion problem per Section 1.2.2.

Water Quality: Sensitive Lake Water Quality Menu

The Sensitive Lake Protection Water Quality Menu includes two pollutant removal targets and includes the control of phosphorous as follows:

- Total Suspended Solids (TSS) = 80% reduction
- Total Phosphorus = 50% reduction

The Sensitive Lake Protection Menu, described in detail in Section 6.1.3 provides four options to meet the pollutant removal targets listed above.

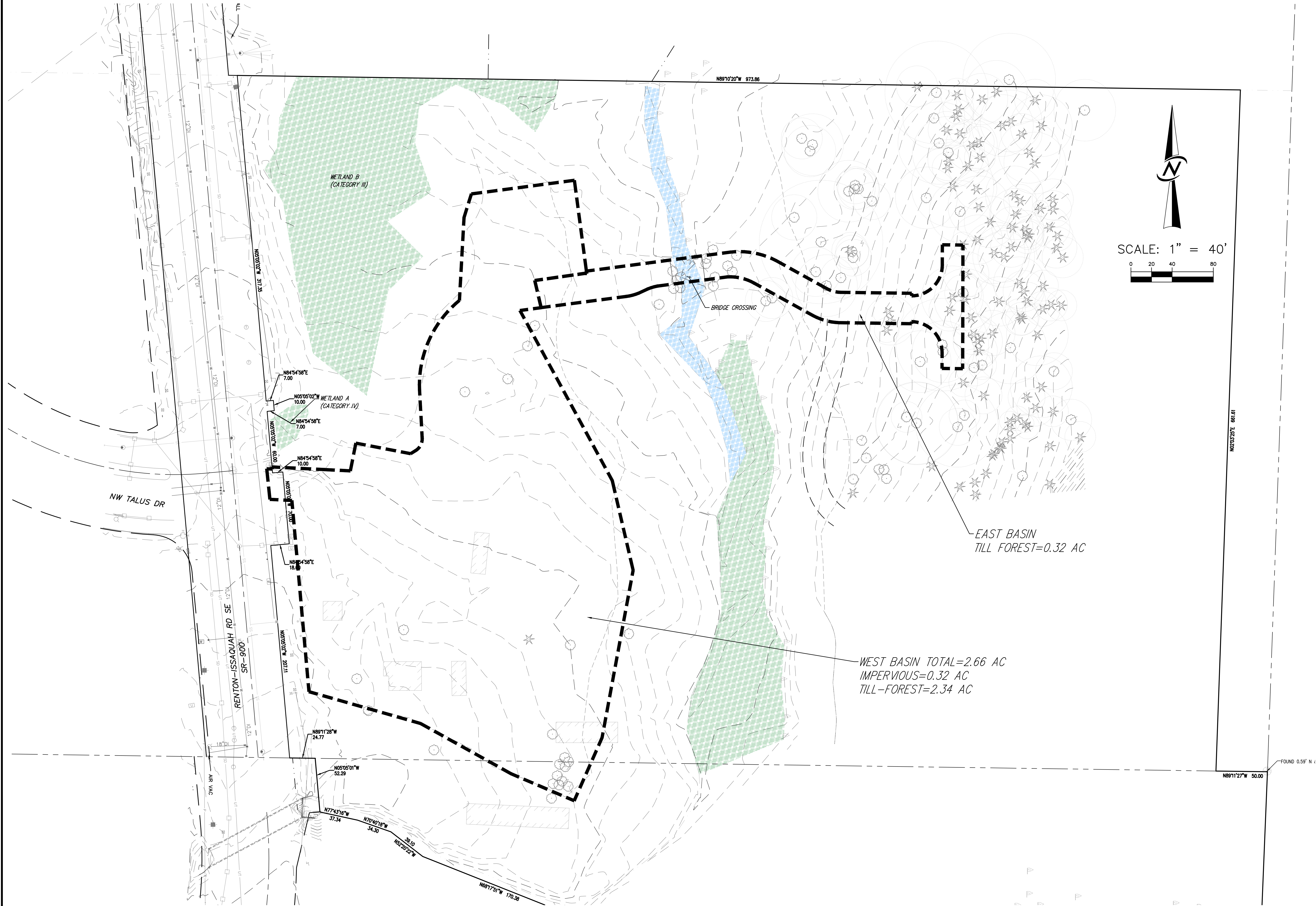
- Option 1: Large Wetpond
- Option 2: Large Sand Filter
- Option 3: Two-Facility Treatment Train
- Option 4: Basic Menu Plus Phosphorous Credit

The project elects to utilize Lake Protection Option 4, which allows the project to use the Basic water quality menu while earning credit for proposing a land use action that reduces phosphorus in stormwater runoff. The project will comply with credit-earning action #1, which requires the project to leave at least 65% of the site undisturbed, including undevelopable land. The project proposes to develop 4.44 acres of the 21.94 acre site, leaving 80% of the site undeveloped and earning the phosphorus credit for option 4. Therefore, the project is subject to the basic water quality menu. The project will implement basic water quality option 4: Wetvault, utilizing dead storage volume within the detention vaults proposed for flow control.

More detailed discussion and sizing calculations of the flow control and water quality treatment facility proposed for this project follows later in this section.

9/19/2018 10:19 AM 1:2017171271 [DOCUMENTS] [ENGINEERING REPORTS] [R] [PRELIM] [SECTION 4] [17127] 6400-EX COND.DWG

SE 1/4, SEC. 29 & NE 1/4, SEC. 32, TWP. 24 N., RGE. 6 E., W.M.



DATE AUGUST 2018		DESIGNED SHERI H. MURATA, P.E.	
DRAWN DAVID S. VAUGHN		APPROVED SHERI H. MURATA, P.E.	
PROJECT NUMBER 17127		PROJECT MANAGER SHERI H. MURATA, P.E.	
SHEET C4.00			
OF 13			
FIGURE 4-1: EXISTING CONDITIONS TIBBETTS CROSSING STEVE BURNSTEAD CONSTRUCTION, LLC 17980 NE 24TH STREET SUITE 200 BELLEVUE, WA 98005			
CORE DESIGN ENGINEERING • PLANNING • SURVEYING			
14711 NE 29th Place Suite 101 Bellevue, Washington 98007 425.885.7877 Fax 425.885.7963			
NO. REVISIONS			
DATE			

9/17/18

4.4 Flow Control System

Calculation of Impervious Area

The minimum impervious area per lot per the 2009 KCSWDM (page 3-27) would either be 4,000 square feet per lot or the maximum impervious area per zoning, whichever is less. The project has estimated 50% impervious coverage as the maximum allowed for each lot based on zoning.

Flow Control BMPs/Individual Lot BMPs

This project proposes to implement various flow control BMPs to reduce runoff volumes and decrease the size of the detention facilities through credits as allowed in Section 5.2.2 of the 2009 KCSWDM. The project contains lots that are under 22,000 square feet, therefore the project is subject to the small lot BMP requirements listed in Section 5.2.1.1 of the 2009 KCSWDM. The requirements and responses for each are listed below.

1. The feasibility and applicability of full dispersion as detailed in Appendix C, Section C.2.1 must be evaluated for the roof area (or an impervious area of equivalent size) on the site/lot. If feasible and applicable, full dispersion of roof runoff must be implemented as part of the proposed project. Typically, small lot full dispersion will be applicable only in subdivisions where enough forest was preserved by tract, easement or covenant to meet the minimum requirements for full dispersion in Appendix C, Section C.2.1.1. If this first requirement is met for the site/lot, no other flow control BMPs are required, and the remaining requirements below are optional.

Response: *The project proposes to implement full dispersion on lots where the flow path can be supported. A total of 33,298 square feet of impervious roof area will be mitigated using full dispersion. By implementing full dispersion, the project is able to model all fully dispersed surfaces as forest when sizing the detention facilities. This credit has been accounted for in tables 4-2 and 4-3 above.*

2. Where full dispersion of roof runoff (or equivalent) is not feasible or applicable, or will cause flooding or erosion impacts, the feasibility and applicability of full infiltration as detailed in Appendix C, Section C.2.2 must be evaluated for roof runoff (note, this will require a soils report for the site/lot). If feasible and applicable, full infiltration of roof runoff must be implemented as part of the proposed project. If this requirement or the full dispersion requirement above is met for the site/lot, no other flow control BMPs are required, and the remaining requirements below are optional.

Response: *Full infiltration will be implemented on several of the lots in the east basin where infiltration is feasible and applicable. The project will mitigate a total of 5,000 square feet of impervious roof area using infiltration, allowing the project to remove the mitigated area for modeling of the detention facilities per Table 5.2.2.A of the 2009 KCSWDM.*

3. Where full dispersion or full infiltration of roof runoff as specified in Requirements 1 and 2 above is not feasible or applicable, or will cause flooding or erosion impacts, one or more of the following BMPs must be applied to (or used to mitigate for) an impervious area equal to at least 10% of the site/lot for site/lot sizes up to 11,000 square feet and at least 20% of the site/lot for site/lot sizes between 11,000 and 22,000 square feet. For projects located in critical aquifer recharge areas, these impervious area amounts must be doubled. The BMPs listed below may be located anywhere on the site/lot subject to the limitations and design specifications for each BMP. These BMPs must be implemented as part of the proposed project.

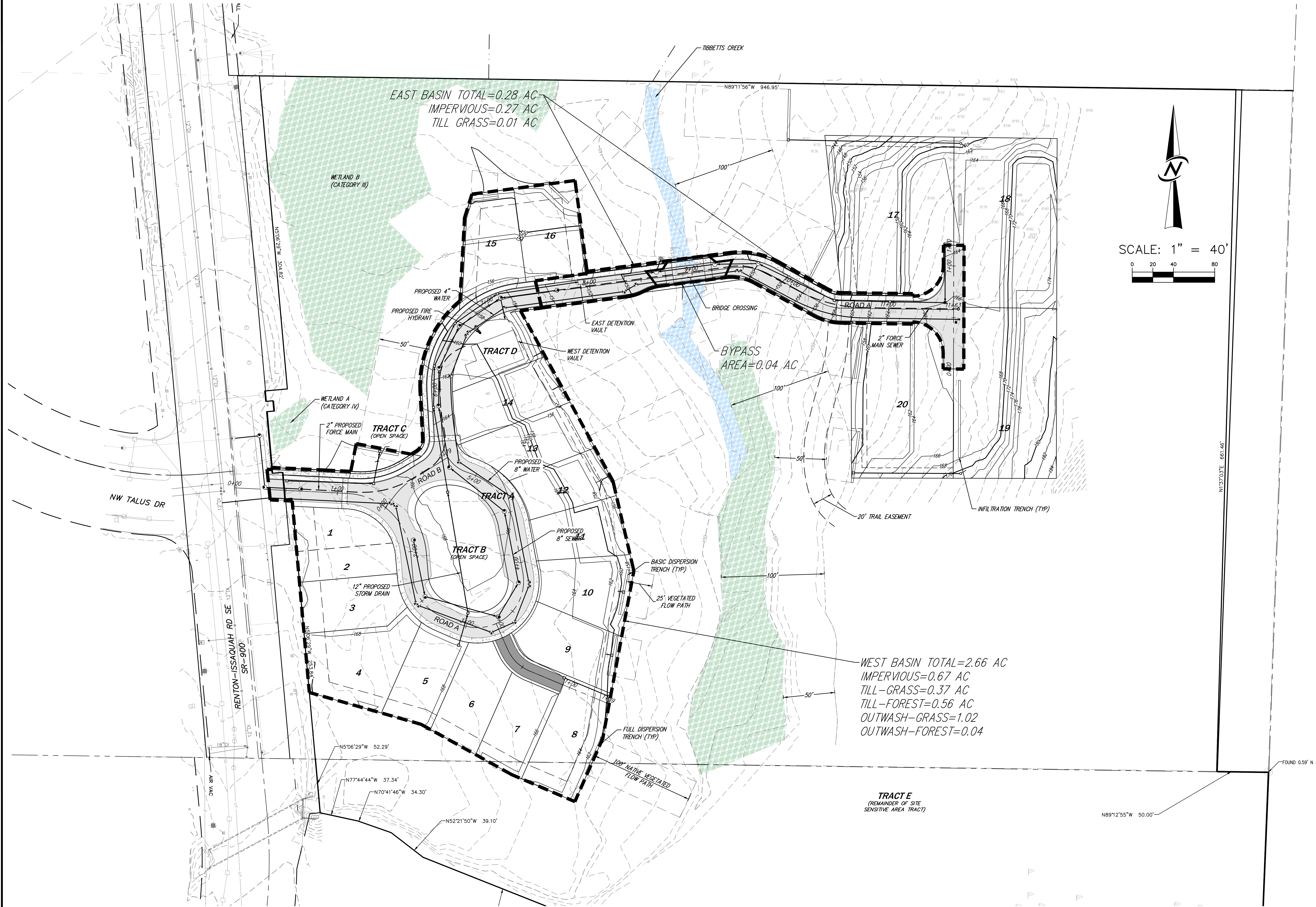
- Limited Infiltration

<ul style="list-style-type: none">• Basic Dispersion

- Rain Garden
- Permeable Pavement
- Rainwater Harvesting
- Vegetated Roof
- Reduced Impervious Surface Credit
- Native Growth Retention Credit

Response: *The project proposes to implement sheetflow (basic) dispersion for impervious roof area that is not mitigated through full dispersion or full infiltration. A total of 11,564 square feet of impervious roof area will be mitigated using sheetflow dispersion.*

In addition to the BMPs implemented for impervious roof area, the project proposes basic sheetflow dispersion BMPs for the impervious roadway and full dispersion where feasible. A total of 14,981 square feet of impervious road surface will be mitigated using dispersion BMPs. Refer to the Developed Condition Exhibit at the end of this section for locations of all proposed flow control BMPs for the project site.



DATE: AUGUST 2018		DESIGNED: SHERI H. MURATA, P.E.	
DRAWN: DAVID S. VAUGHN		APPROVED: SHERI H. MURATA, P.E.	
PROJECT NUMBER: 17127		PROJECT MANAGER: SHERI H. MURATA, P.E.	
SHEET 13 OF 13			
PROJECT NUMBER: 17127			
FIGURE 4-2. DEVELOPED CONDITIONS TIBBETTS CROSSING STEVE BURNSTEAD CONSTRUCTION, LLC 17980 NE 24TH STREET SUITE 200 BELLEVUE, WA 98005			
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NO. REVISIONS			
DATE			

Detention Vaults

The West Vault has been sized to receive runoff from the entry road and the entire west basin, after accounting for all flow control BMP facility sizing credits, per Table 5.2.2.A of the 2009 KCSWDM. A flow splitter will be utilized to divert flows that have been designated for full dispersion as discussed in the previous section. The east tank is unable to meet the flow control standard for the east basin, so the west tank will over detain the runoff from the west basin to accommodate. The combined outflow of the east and west detention tanks as well as the 0.04 acres of bypass will meet the level 2 flow control standard for the entire site. The KCRTS summaries for the west and east detention vaults are shown in this section.

West - KCRTS Vault Calculation

Type of Facility:	Detention Vault			
Facility Length:	50.00	ft		
Facility Width:	25.00	ft		
Facility Area:	1250.	sq. ft		
Effective Storage Depth:	8.80	ft		
Stage 0 Elevation:	0.00	ft		
Storage Volume:	11000.	cu. ft		
Riser Head:	8.80	ft		
Riser Diameter:	12.00	inches		
Number of orifices:	3			
Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.38	0.152	
2	3.00	1.00	0.065	4.0
3	6.50	1.00	0.041	4.0
Top Notch Weir: None				
Outflow Rating Curve: None				

The proposed detention vault includes a three orifice control structure. Locations and sizes of the orifices can be seen in the previous KCRTS summary.

East - KCRTS Vault Calculation

Type of Facility: Detention Vault				
Facility Length:		45.00	ft	
Facility Width:		5.00	ft	
Facility Area:		225.	sq. ft	
Effective Storage Depth:		4.80	ft	
Stage 0 Elevation:		0.00	ft	
Storage Volume:		1080.	cu. ft	
Riser Head:		4.80	ft	
Riser Diameter:		12.00	inches	
Number of orifices:		2		
			Full Head	Pipe
Orifice #	Height	Diameter	Discharge	Diameter
	(ft)	(in)	(CFS)	(in)
1	0.00	1.00	0.059	
2	3.50	0.75	0.017	4.0
Top Notch Weir: None				
Outflow Rating Curve: None				

Since the point of compliance is downstream of both vaults, the outflow of the East vault was modeled as a tributary time series file to the West vault. Therefore, the outflow at the point of compliance is 0.164 cfs for the 2-year event and 0.273 cfs for the 10-year event as shown in the KCRTS modeling file below. Note that both the 2-year and 10-year release rates are below the target peak flow rates of 0.185 cfs and 0.311 cfs respectively from the output file also shown below.

Flow Frequency Analysis							
Time Series File:dsout_total.tsf							
Project Location:Landsburg							
---Annual Peak Flow Rates---				-----Flow Frequency Analysis-----			
Flow Rate	Rank	Time of Peak		- - Peaks - -	Rank	Return	Prob
(CFS)				(CFS)		Period	
0.303	2	2/09/01	15:00	0.981	1	100.00	0.990
0.087	8	12/03/01	22:00	0.303	2	25.00	0.960
0.182	5	2/28/03	8:00	0.273	3	10.00	0.900
0.116	7	8/23/04	22:00	0.188	4	5.00	0.800
0.188	4	1/05/05	11:00	0.182	5	3.00	0.667
0.164	6	1/18/06	22:00	0.164	6	2.00	0.500
0.273	3	11/24/06	6:00	0.116	7	1.30	0.231
0.981	1	1/09/08	8:00	0.087	8	1.10	0.091
Computed Peaks				0.755		50.00	0.980

Flow Frequency Analysis
Time Series File:predev.tsf
Project Location:Landsburg

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-----			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.347	2	2/09/01 15:00	0.509	1	100.00	0.990
0.105	8	1/05/02 16:00	0.347	2	25.00	0.960
0.246	4	2/28/03 16:00	0.311	3	10.00	0.900
0.149	7	8/26/04 1:00	0.246	4	5.00	0.800
0.228	5	1/05/05 10:00	0.228	5	3.00	0.667
0.185	6	1/18/06 16:00	0.185	6	2.00	0.500
0.311	3	11/24/06 5:00	0.149	7	1.30	0.231
0.509	1	1/09/08 7:00	0.105	8	1.10	0.091
Computed Peaks			0.455		50.00	0.980

The flow duration comparison analysis results for the provided detention vault are shown below and there is no positive excursion.

Duration Comparison Analysis

Base File: predev.tsf

New File: dsout_total.tsf

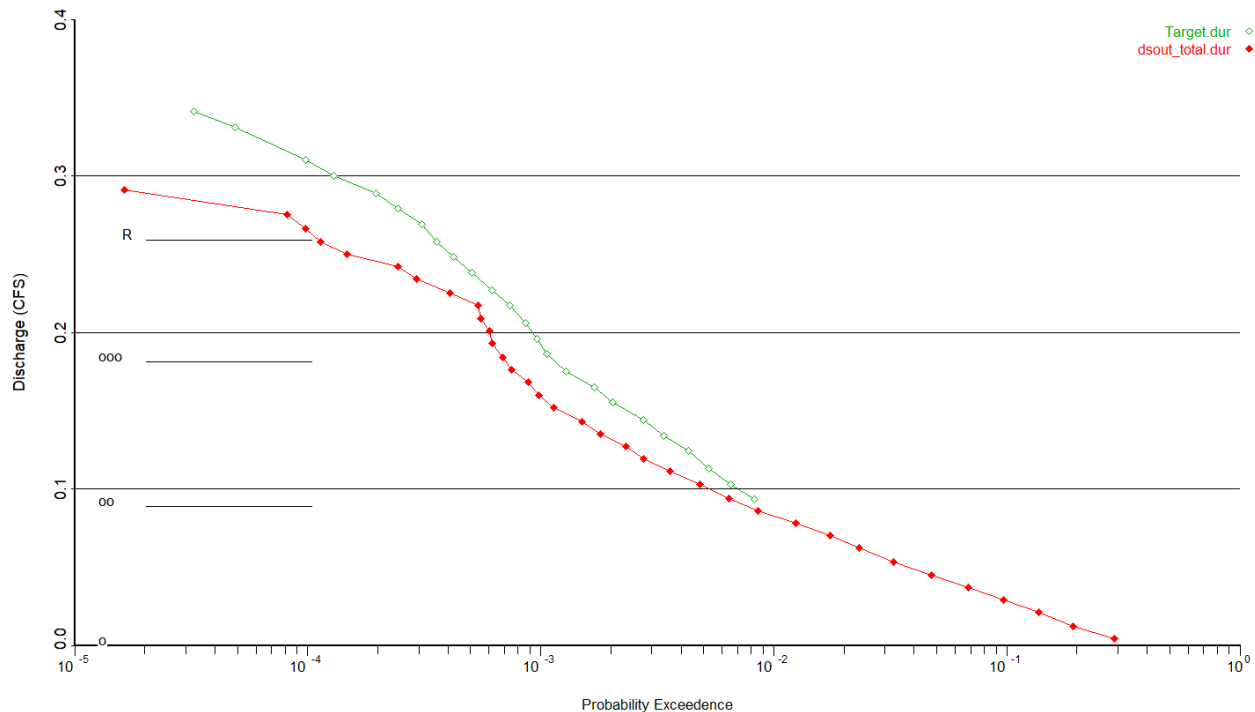
Cutoff Units: Discharge in CFS

-----Fraction of Time-----				-----Check of Tolerance-----			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.092	0.83E-02	0.76E-02	-9.0	0.83E-02	0.092	0.090	-3.1
0.112	0.54E-02	0.38E-02	-28.6	0.54E-02	0.112	0.103	-7.9
0.132	0.36E-02	0.23E-02	-35.4	0.36E-02	0.132	0.114	-13.8
0.151	0.22E-02	0.14E-02	-35.8	0.22E-02	0.151	0.134	-11.5
0.171	0.14E-02	0.90E-03	-37.5	0.14E-02	0.171	0.151	-11.5
0.190	0.10E-02	0.64E-03	-38.1	0.10E-02	0.190	0.163	-14.6
0.210	0.80E-03	0.57E-03	-28.6	0.80E-03	0.210	0.179	-14.6
0.230	0.57E-03	0.52E-03	-8.6	0.57E-03	0.230	0.218	-5.1
0.249	0.42E-03	0.34E-03	-19.2	0.42E-03	0.249	0.238	-4.7
0.269	0.31E-03	0.13E-03	-57.9	0.31E-03	0.269	0.258	-4.1
0.288	0.20E-03	0.82E-04	-58.3	0.20E-03	0.288	0.265	-8.1
0.308	0.98E-04	0.00E+00	-100.0	0.98E-04	0.308	0.282	-8.5
0.328	0.49E-04	0.00E+00	-100.0	0.49E-04	0.328	0.291	-11.0
0.347	0.16E-04	0.00E+00	-100.0	0.16E-04	0.347	0.303	-12.7

There is no positive excursion

Maximum negative excursion = 0.036 cfs (-17.8%)
occurring at 0.201 cfs on the Base Data:predev.tsf
and at 0.165 cfs on the New Data:dsout_total.tsf

Figure 4-3: Flow Durations Plot



4.5 Water Quality Calculations

Water Quality treatment is required for new and replaced pollution generating impervious surfaces and new pollution generating pervious surfaces (PGIS).

The project is subject to the Sensitive Lake Water Quality standard. The Sensitive Lake Protection Menu, described in detail in Section 6.1.3 provides four options to meet the pollutant removal targets listed above.

- Option 1: Large Wetpond
- Option 2: Large Sand Filter
- Option 3: Two-Facility Treatment Train
- Option 4: Basic Menu Plus Phosphorous Credit

The project elects to utilize Lake Protection Option 4, which allows the project to use the Basic water quality menu while earning credit for proposing a land use action that reduces phosphorus in stormwater runoff. Because the project elects to leave over 65% of the site undeveloped, the project is

able to use the basic water quality menu. Water quality treatment will be accommodated with a combined detention/water quality treatment vault in the form of dead storage.

BASIC WETVAULT - (DEAD STORAGE)

The required dead storage volume needed within the vaults to meet the water quality standard was determined using procedures provided in Section 6.4.1.1 of the 2009 KCSWDM. Areas tabulated below are the subject site's developed areas tributary to the vaults.

$$V_B = f V_r$$

where: f = volume correction factor = 3 (Basic)

V_r = volume of runoff from mean annual storm, CF

$$V_r = (0.9A_i + 0.25A_{tg} + 0.10A_{tf} + 0.01A_o) \times R$$

where: A_i = area of impervious surface, SF

A_{tg} = area of till grass and pasture, SF

A_{tf} = area of till forest, SF

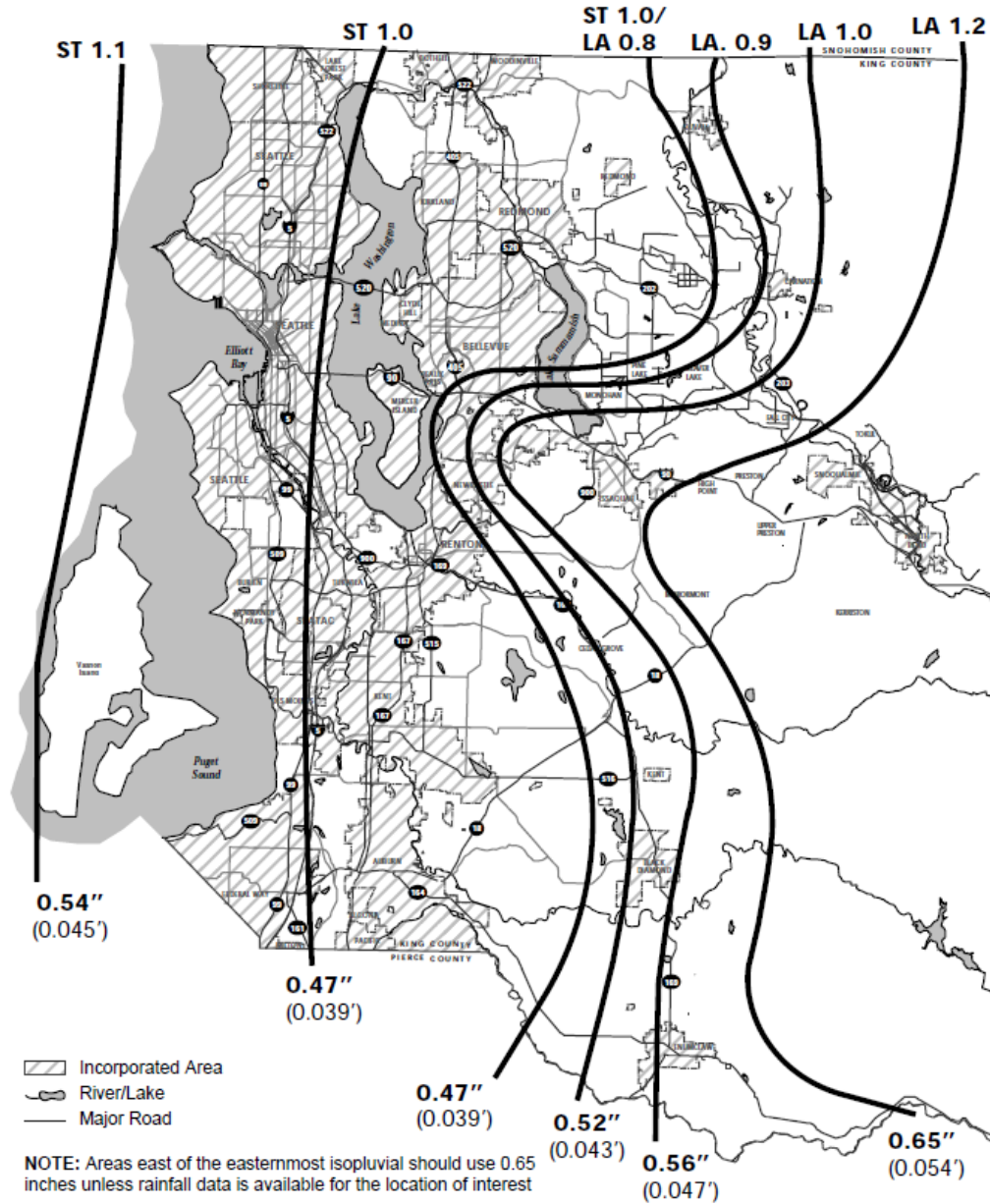
A_o = area of outwash soils, SF

R = rainfall from mean annual storm = 0.05 feet (from Fig 6.4.1.A at the end of this section.)

$$V_B = 3[0.9(0.98) + 0.25(0.38) + 0.1(0.56) + 0.01(1.06)] \times 43,560 \times 0.05 = 6,819 \text{ CF}$$

A dead storage volume of 6,819 cubic feet is necessary to satisfy the water quality requirement for the entire site. Assuming an average of 5 feet of dead storage, the on site vaults provide a total of 7,375 CF of storage volume. The provided volume is greater than the required volume calculated above, meeting the water quality requirement for the site.

FIGURE 6.4.1.A PRECIPITATION FOR MEAN ANNUAL STORM IN INCHES (FEET)



5 CONVEYANCE SYSTEM ANALYSIS AND DESIGN

Conveyance calculations to be provided with final engineering.

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6 SPECIAL REPORTS AND STUDIES

(Under separate cover)

The following reports and assessments are provided for reference and informational purposes only. Core Design takes no responsibility or liability for these reports, assessments or designs as they were not completed under the direct supervision of Core Design.

- Tibbetts Creek Traffic Analysis
Prepared by: Michael Read, P.E.
Dated: September 5, 2018
TENW
11400 SE 8th Street, Suite 200
Bellevue, Wa 98004

- Arborist Report, Tibbetts Crossing
Prepared by: Lonnie Olson, ISA Certified Arborist
Dated: July 9, 2018
Lonnson Arbor Care
2616 169th Street SE
Bothell, WA 98012

- Preliminary Geotechnical Engineering Report
Prepared by: Matthew A. Miller, P.E.
Dated: May 12, 2017
Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, WA 98033

- Critical Area Study
Prepared by: Wetland Resources, Inc.
Dated: August 5, 2015
Wetland Resources, Inc.
9505 19th Ave SE, Suite 106
Everett, WA 98208

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7 OTHER PERMITS

- NPDES Permit
- Building Permits
- ROW Use Permit
- Site Work Permit

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8 ESC ANALYSIS AND DESIGN

Erosion and sediment control analysis to be provided during final engineering.

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9 BOND QUANTITIES, FACILITY SUMMARIES, AND DECLARATION OF COVENANT

9.1 Bond Quantities

A bond quantity worksheet will be provided during final engineering.

9.2 Facility Summaries

Not applicable.

9.3 Declaration of Covenant


A Declaration of Covenant will be provided during final engineering.

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10 OPERATIONS AND MAINTENANCE

The operations and maintenance information will be provided through select portions from Appendix A of the 2009 KCSWDM during Final Engineering.

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Appendix A

Parcel & Basin Information

- King County Parcel Report
- Figure 2-2 Stormwater Drainage Sub-basins in Issaquah

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PARCEL

Parcel Number	292406-9041
Name	STEVE BURNSTEAD CONSTRUCTIO
Site Address	7932 RENTON-ISSAQUAH RD SE 98027
Legal	LOT B ISSAQUAH LLA #PLN12-00027 REC #20121213900009 SD LLA BEING POR S 1/2 OF SE 1/4 OF SE 1/4 STR 29-24-6 LESS RD TGW POR NE 1/4 OF NE 1/4 LY ELY OF RD STR 32-24-6

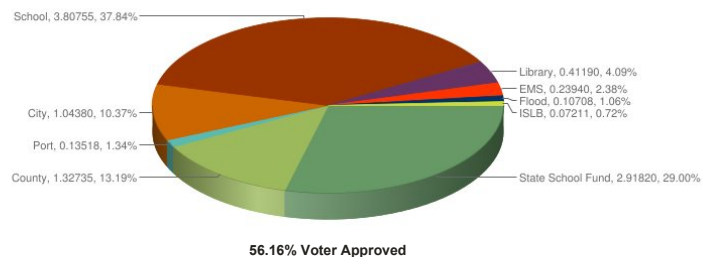
BUILDING 1

Year Built	1922
Total Square Footage	2290
Number Of Bedrooms	5
Number Of Baths	1.00
Grade	7 Average
Condition	Good
Lot Size	955902
Views	No
Waterfront	



TOTAL LEVY RATE DISTRIBUTION

Tax Year: 2018 Levy Code: 1404 Total Levy Rate: \$10.06257 Total Senior Rate: \$4.92228

[Click here to see levy distribution comparison by year.](#)

TAX ROLL HISTORY

Valued Year	Tax Year	Appraised Land Value (\$)	Appraised Imps Value (\$)	Appraised Total (\$)	Taxable Land Value (\$)	Taxable Imps Value (\$)	Taxable Total (\$)
2018	2019	883,000	166,000	1,049,000	883,000	166,000	1,049,000
2017	2018	772,000	136,000	908,000	772,000	136,000	908,000
2016	2017	715,000	98,000	813,000	715,000	98,000	813,000
2015	2016	681,000	156,000	837,000	681,000	156,000	837,000
2014	2015	617,000	142,000	759,000	617,000	142,000	759,000
2013	2014	561,000	98,000	659,000	561,000	98,000	659,000
2012	2013	761,200	79,000	840,200	761,200	79,000	840,200
2011	2012	472,000	69,000	541,000	472,000	69,000	541,000
2010	2011	498,000	80,000	578,000	498,000	80,000	578,000
2009	2010	451,000	24,000	475,000	451,000	24,000	475,000
2008	2009	502,000	98,000	600,000	502,000	98,000	600,000
2007	2008	453,000	95,000	548,000	453,000	95,000	548,000
2006	2007	394,000	112,000	506,000	394,000	112,000	506,000
2005	2006	365,000	116,000	481,000	365,000	116,000	481,000
2004	2005	345,000	111,000	456,000	345,000	111,000	456,000
2003	2004	345,000	111,000	456,000	345,000	111,000	456,000
2002	2003	340,000	247,000	587,000	340,000	247,000	587,000

Reference Links:

- [King County Taxing Districts Codes and Levies \(.PDF\)](#)
- [King County Tax Links](#)
- [Property Tax Advisor](#)
- [Washington State Department of Revenue](#) (External link)
- [Washington State Board of Tax Appeals](#) (External link)
- [Board of Appeals/Equalization](#)
- [Districts Report](#)
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Notice mailing date:
07/05/2018

2001	2002	321,000	235,000	556,000	321,000	235,000	556,000
2000	2001	292,000	226,000	518,000	292,000	226,000	518,000
1999	2000	254,000	95,000	349,000	254,000	95,000	349,000
1998	1999	221,000	73,000	294,000	221,000	73,000	294,000
1997	1998	0	0	0	211,000	69,000	280,000
1996	1997	0	0	0	211,000	1,000	212,000
1994	1995	0	0	0	211,000	1,000	212,000
1992	1993	0	0	0	159,300	43,200	202,500
1990	1991	0	0	0	141,000	38,200	179,200
1988	1989	0	0	0	126,900	32,900	159,800
1986	1987	0	0	0	126,900	31,300	158,200
1984	1985	0	0	0	139,600	30,600	170,200
1982	1983	0	0	0	139,600	30,600	170,200

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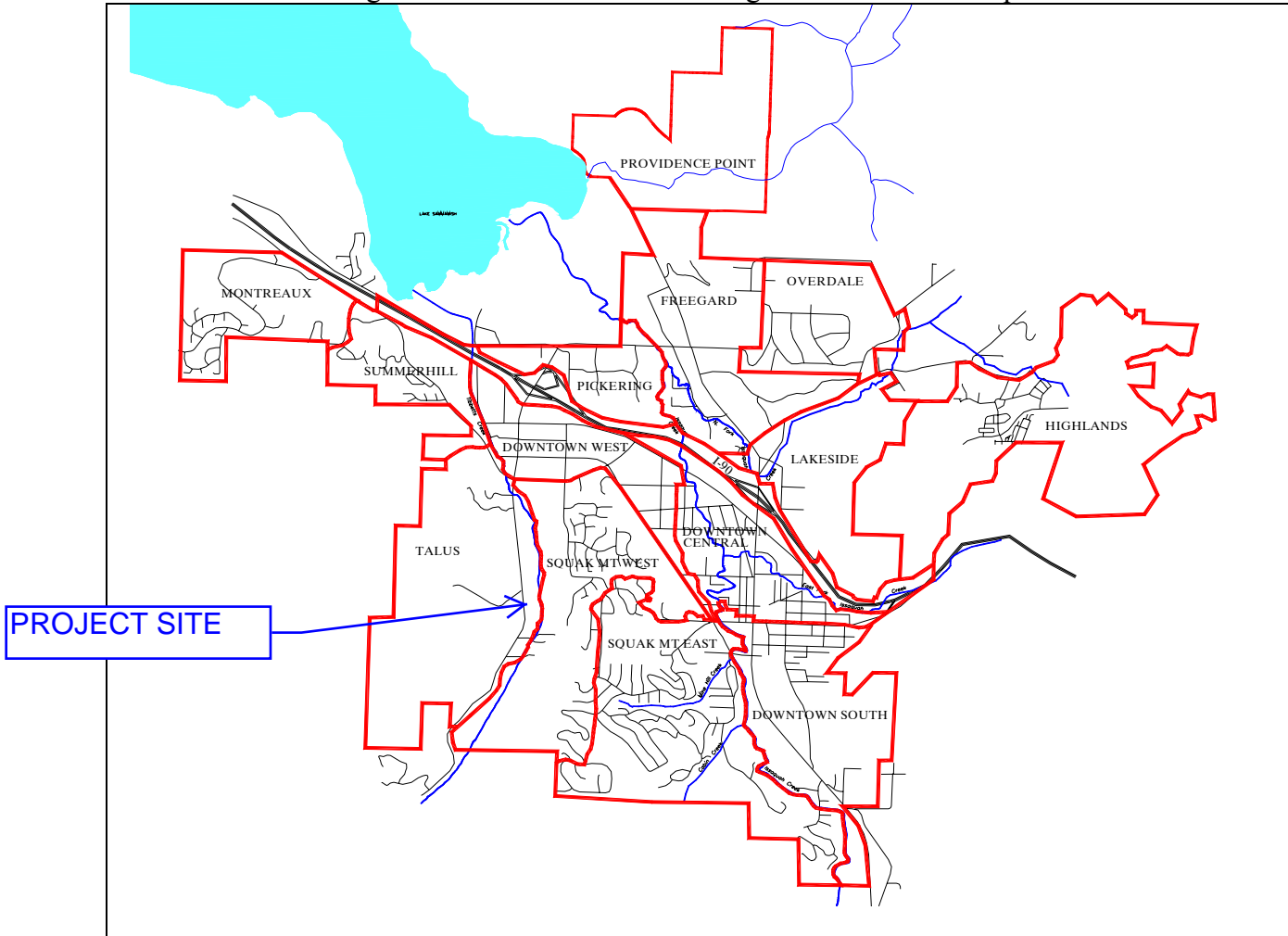
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Figure 2-2 Stormwater Drainage Sub-basins in Issaquah



2.2.3 Fish Usage


Table 2-4 summarizes the important fish species that are present in the principal streams in Issaquah, as reported by the Final Issaquah Creek Basin and Non-point Action Plan and the Issaquah Creek Basin Draft Sub-Area Summary.

Table 2-4 Fish Presence in Issaquah Streams

Stream	Species
Issaquah Creek	Chinook, Sockeye, Steelhead, Dolly Varden, Coho, Cutthroat, Rainbow, Kokanee, Bull trout
North Fork Issaquah Creek	Sockeye, Coho, Cutthroat
East Fork Issaquah Creek	Sockeye, Coho, Cutthroat, Chinook, Rainbow
Tibbetts Creek	Coho, Sockeye, Cutthroat

Major species of salmon are described below:

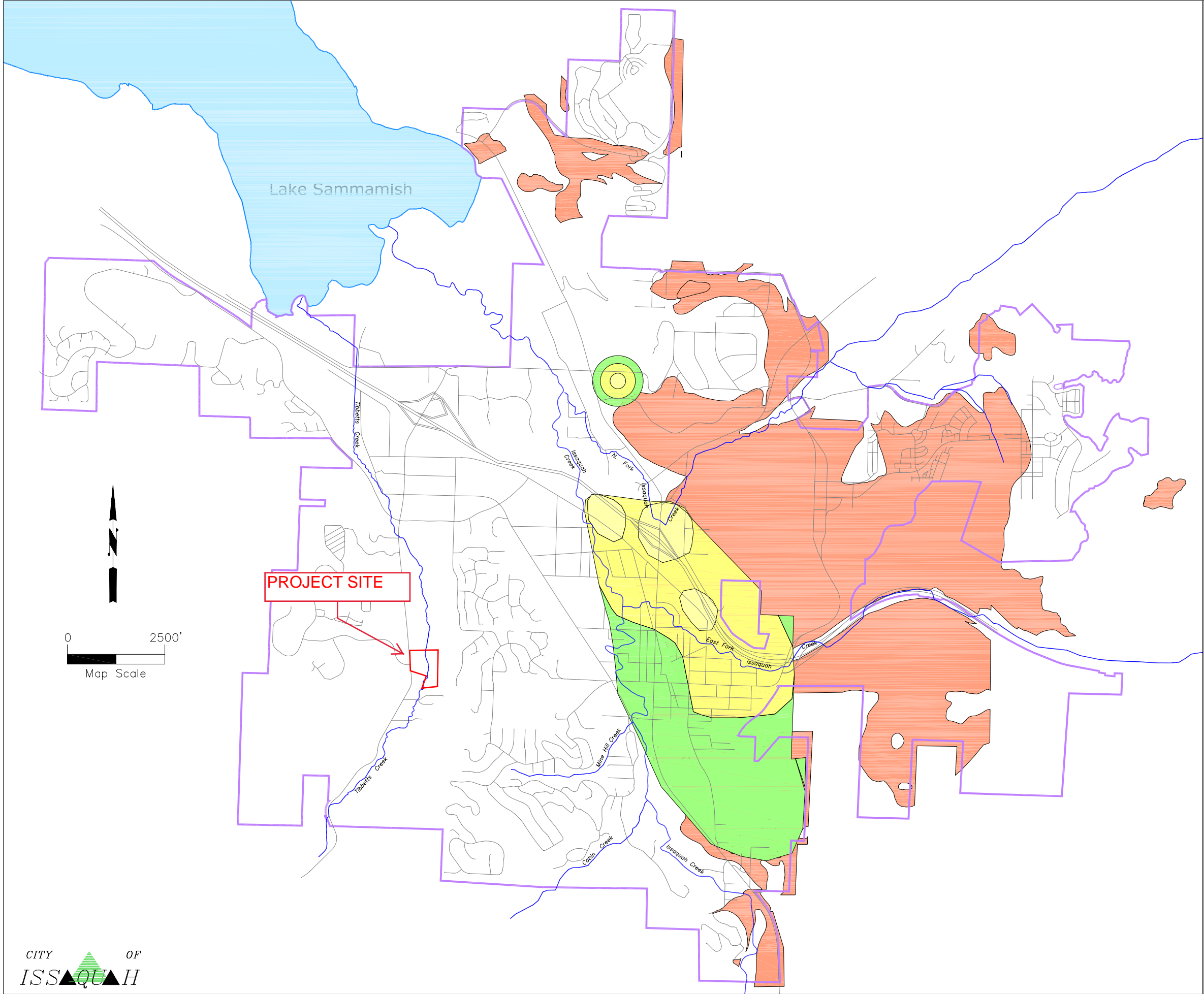
- **Chinook salmon**, also called "king," is the largest of the Pacific Salmon. Chinook have been observed spawning 11 miles upstream on Issaquah Creek in Holder and Carey creeks. They are often found spawning in rivers or larger streams, and are usually one of the earlier salmon species to spawn in the fall. Chinook salmon in Issaquah Creek is entirely of hatchery origin,



Appendix B

Resource Review & Off-site Analysis Documentation




- Critical Aquifer Recharge Area Classification Map
 - FEMA Map (53033C0693G)
 - USDA NRCS Site Soils Map
 - Drainage Complaints Exhibit



CRITICAL AQUIFER RECHARGE AREA CLASSIFICATION MAP

LEGEND

CARA CLASSES

-  Class 1 - 1 & 5 year Wellhead Capture Zone
-  Class 2 - 10 year Wellhead Capture Zone
-  Class 3 - High Aquifer Recharge Area

Notes:

1) CARA Class 1 and Class 2 are based on wellhead capture zones that are documented in Lower Issaquah Valley Wellhead Protection Plan (Golder Associates, 1993) and Wellhead Protection Delineation for Overdale Well (Golder Associates, 1997).

2) CARA Class 3— High Aquifer Recharge Area is based on surficial geology and soil units have high to moderate susceptibility to contamination. Sources for recharge area mapping include: Geologic Map of the Issaquah 7.5' Quadrangle (Booth and Minard, 1992) for all areas except Issaquah Highlands; Report on Geotechnical Services, Draft Environmental Impact Statement for Proposed Grand Ridge Development (Geoengineers, 1995) for Issaquah Highlands; and King County Soil Survey (U.S. Soil Conservation Service, 1973) for all areas.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevation** (BFEs) and/or **Floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevation (BFEs) shown on this map apply only landward of 0.0' National Geodetic Vertical Datum (NGVD). Users of this FIRM should be aware that coastal flood elevations may also be provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map is Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** is NAD27, CLARKE1866 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the U.S. Bureau of Census TIGER files and have been geospatially corrected.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

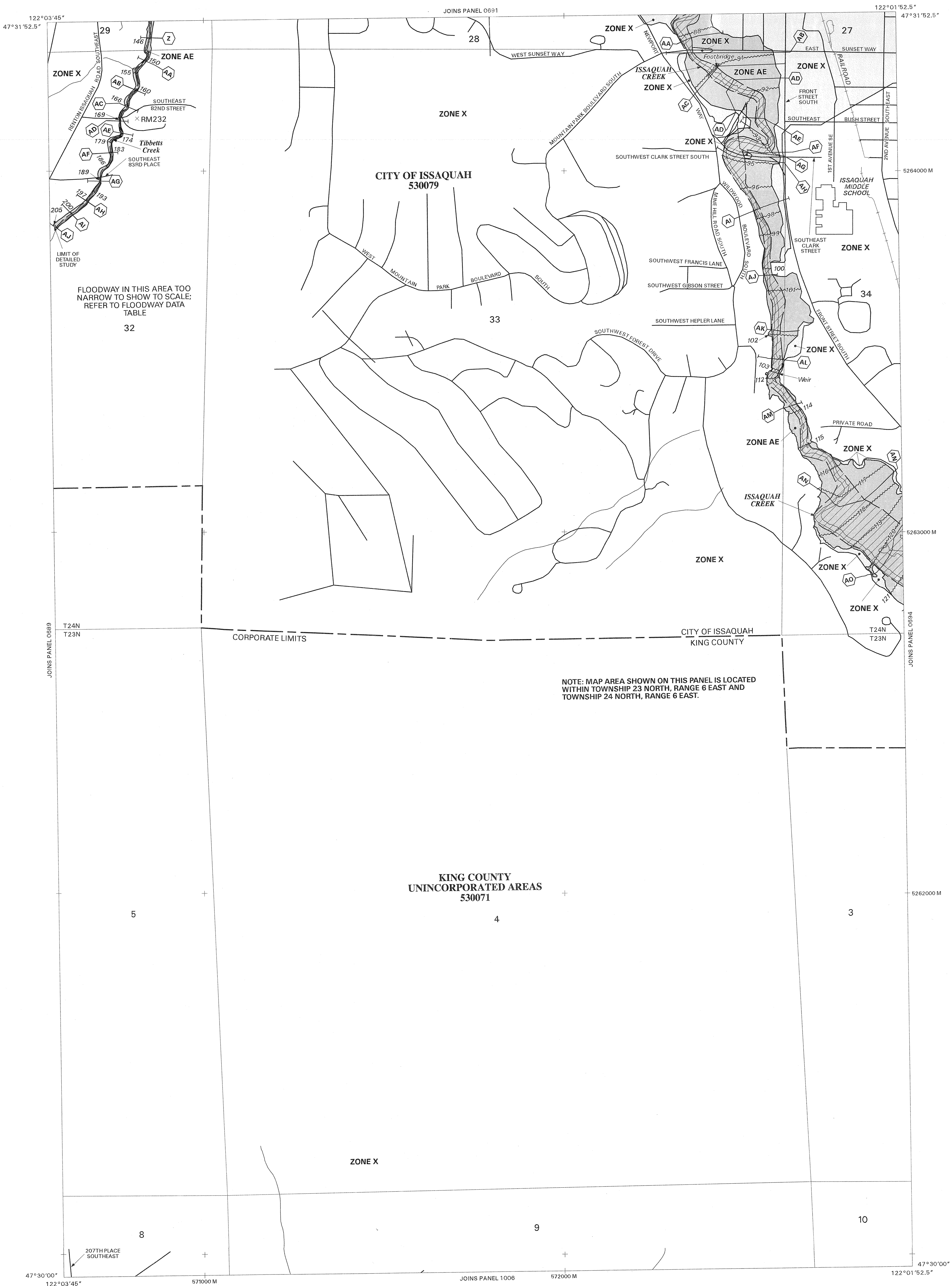
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

An accompanying Flood Insurance Study report, Letters of Map Revision or Letters of Map Amendment revising portions of this panel, and digital versions of this PANEL may be available. Contact the **FEMA Map Service Center** at the following phone numbers and Internet address for information on all related products available from FEMA:

Phone: 800-358-9616
FAX: 800-358-9620
www.fema.gov/msc

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at www.fema.gov.

This map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report may reflect stream channel distances that differ from what is shown on this map.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD EVENT

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

- ZONE A** No base flood elevations determined.
- ZONE AE** Base flood elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood event.
- ZONE A99** Area to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no base flood elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or velocities.
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*
- *Referenced to the National Geodetic Vertical Datum of 1929
- Cross Section Line
- Transect Line
- Geographic coordinates referenced to the North American Datum of 1927 (NAD 27)
- 1000-meter Universal Transverse Mercator grid values, zone 10
- 600000 FT
- 5000-foot grid ticks
- Bench mark (see explanation in Notes to Users section of this FIRM panel).
- River Mile

MAP REPOSITORY
Refer to Repository Listing on Index Map

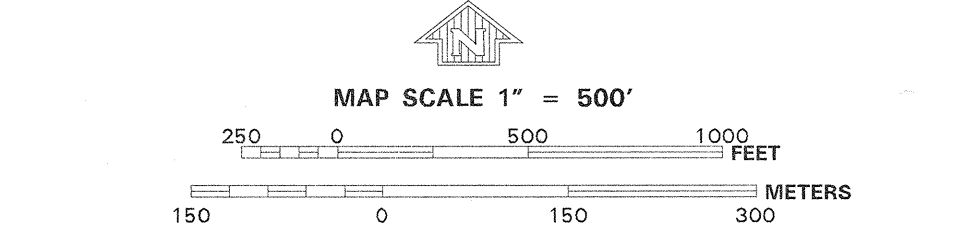
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
SEPTEMBER 28, 1989

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
MAY 16, 1995

April 19, 2005: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to add roads and road names, to reflect updated topographic information.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0693G

FIRM
FLOOD INSURANCE RATE MAP
KING COUNTY,
WASHINGTON
AND INCORPORATED AREAS

PANEL 693 OF 1725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KING COUNTY, UNINCORPORATED AREAS	530071	0693	G
ISSAQUAH, CITY OF	530079	0693	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53033C0693G

MAP REVISED:
APRIL 19, 2005


Federal Emergency Management Agency

Soil Map—King County Area, Washington



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: King County Area, Washington

Survey Area Data: Version 13, Sep 7, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2014—Jul 15, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AgD	Alderwood gravelly sandy loam, 15 to 30 percent slopes	3.7	20.4%
EvC	Everett very gravelly sandy loam, 8 to 15 percent slopes	1.0	5.7%
KpB	Kitsap silt loam, 2 to 8 percent slopes	2.4	12.9%
KpD	Kitsap silt loam, 15 to 30 percent slopes	0.6	3.2%
Ma	Mixed alluvial land	10.5	57.7%
Totals for Area of Interest		18.3	100.0%

Drainage Complaint Exhibit



Pictometry, King County, King County


The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.

Date: 9/6/2018

Notes:



 **King County**
GIS CENTER



Appendix C

Vault Sizing

- West Vault Summary
- East Vault Summary
- Site Flow Frequency Plot
- Site Flow Duration Plot

Retention/Detention Facility

Type of Facility: West Detention Vault
 Facility Length: 50.00 ft
 Facility Width: 25.00 ft
 Facility Area: 1250. sq. ft
 Effective Storage Depth: 8.80 ft
 Stage 0 Elevation: 0.00 ft
 Storage Volume: 11000. cu. ft
 Riser Head: 8.80 ft
 Riser Diameter: 12.00 inches
 Number of orifices: 3

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.38	0.152	
2	3.00	1.00	0.065	4.0
3	6.50	1.00	0.041	4.0

Top Notch Weir: None
 Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	13.	0.000	0.006	0.00
0.03	0.03	38.	0.001	0.009	0.00
0.04	0.04	50.	0.001	0.011	0.00
0.06	0.06	75.	0.002	0.012	0.00
0.07	0.07	88.	0.002	0.014	0.00
0.09	0.09	113.	0.003	0.015	0.00
0.10	0.10	125.	0.003	0.016	0.00
0.11	0.11	138.	0.003	0.017	0.00
0.13	0.13	163.	0.004	0.018	0.00
0.30	0.30	375.	0.009	0.028	0.00
0.47	0.47	588.	0.013	0.035	0.00
0.65	0.65	813.	0.019	0.041	0.00
0.82	0.82	1025.	0.024	0.046	0.00
0.99	0.99	1238.	0.028	0.051	0.00
1.16	1.16	1450.	0.033	0.055	0.00
1.34	1.34	1675.	0.038	0.059	0.00
1.51	1.51	1888.	0.043	0.063	0.00
1.68	1.68	2100.	0.048	0.067	0.00
1.85	1.85	2313.	0.053	0.070	0.00
2.03	2.03	2538.	0.058	0.073	0.00
2.20	2.20	2750.	0.063	0.076	0.00
2.37	2.37	2963.	0.068	0.079	0.00
2.54	2.54	3175.	0.073	0.082	0.00
2.72	2.72	3400.	0.078	0.085	0.00
2.89	2.89	3613.	0.083	0.087	0.00
3.00	3.00	3750.	0.086	0.089	0.00
3.01	3.01	3763.	0.086	0.089	0.00

3.02	3.02	3775.	0.087	0.090	0.00
3.03	3.03	3788.	0.087	0.091	0.00
3.04	3.04	3800.	0.087	0.093	0.00
3.05	3.05	3813.	0.088	0.095	0.00
3.06	3.06	3825.	0.088	0.097	0.00
3.07	3.07	3838.	0.088	0.097	0.00
3.08	3.08	3850.	0.088	0.098	0.00
3.26	3.26	4075.	0.094	0.106	0.00
3.43	3.43	4288.	0.098	0.113	0.00
3.60	3.60	4500.	0.103	0.118	0.00
3.77	3.77	4713.	0.108	0.123	0.00
3.95	3.95	4938.	0.113	0.128	0.00
4.12	4.12	5150.	0.118	0.133	0.00
4.29	4.29	5363.	0.123	0.137	0.00
4.46	4.46	5575.	0.128	0.141	0.00
4.64	4.64	5800.	0.133	0.145	0.00
4.81	4.81	6013.	0.138	0.149	0.00
4.98	4.98	6225.	0.143	0.153	0.00
5.15	5.15	6438.	0.148	0.156	0.00
5.33	5.33	6663.	0.153	0.160	0.00
5.50	5.50	6875.	0.158	0.163	0.00
5.67	5.67	7088.	0.163	0.166	0.00
5.84	5.84	7300.	0.168	0.170	0.00
6.02	6.02	7525.	0.173	0.173	0.00
6.19	6.19	7738.	0.178	0.176	0.00
6.36	6.36	7950.	0.183	0.179	0.00
6.50	6.50	8125.	0.187	0.181	0.00
6.51	6.51	8138.	0.187	0.182	0.00
6.52	6.52	8150.	0.187	0.183	0.00
6.53	6.53	8163.	0.187	0.184	0.00
6.54	6.54	8175.	0.188	0.185	0.00
6.55	6.55	8188.	0.188	0.187	0.00
6.56	6.56	8200.	0.188	0.189	0.00
6.57	6.57	8213.	0.189	0.190	0.00
6.58	6.58	8225.	0.189	0.191	0.00
6.59	6.59	8238.	0.189	0.191	0.00
6.77	6.77	8463.	0.194	0.200	0.00
6.94	6.94	8675.	0.199	0.207	0.00
7.11	7.11	8888.	0.204	0.213	0.00
7.28	7.28	9100.	0.209	0.219	0.00
7.46	7.46	9325.	0.214	0.224	0.00
7.63	7.63	9538.	0.219	0.229	0.00
7.80	7.80	9750.	0.224	0.234	0.00
7.97	7.97	9963.	0.229	0.238	0.00
8.15	8.15	10188.	0.234	0.243	0.00
8.32	8.32	10400.	0.239	0.247	0.00
8.49	8.49	10613.	0.244	0.251	0.00
8.66	8.66	10825.	0.249	0.255	0.00
8.80	8.80	11000.	0.253	0.259	0.00
8.90	8.90	11125.	0.255	0.569	0.00
9.00	9.00	11250.	0.258	1.130	0.00
9.10	9.10	11375.	0.261	1.870	0.00
9.20	9.20	11500.	0.264	2.660	0.00
9.30	9.30	11625.	0.267	2.940	0.00

9.40	9.40	11750.	0.270	3.200	0.00
9.50	9.50	11875.	0.273	3.440	0.00
9.60	9.60	12000.	0.275	3.660	0.00
9.70	9.70	12125.	0.278	3.870	0.00
9.80	9.80	12250.	0.281	4.060	0.00
9.90	9.90	12375.	0.284	4.250	0.00
10.00	10.00	12500.	0.287	4.430	0.00
10.10	10.10	12625.	0.290	4.600	0.00
10.20	10.20	12750.	0.293	4.760	0.00
10.30	10.30	12875.	0.296	4.920	0.00
10.40	10.40	13000.	0.298	5.080	0.00
10.50	10.50	13125.	0.301	5.230	0.00
10.60	10.60	13250.	0.304	5.370	0.00

Hyd	Inflow	Outflow	Peak		Storage	
			Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.81	0.70	8.92	8.92	11155.	0.256
2	0.45	0.23	7.55	7.55	9442.	0.217
3	0.43	0.18	6.32	6.32	7899.	0.181
4	0.23	0.13	4.17	4.17	5212.	0.120
5	0.27	0.13	4.07	4.07	5082.	0.117
6	0.21	0.11	3.46	3.46	4320.	0.099
7	0.36	0.07	1.90	1.90	2371.	0.054
8	0.19	0.06	1.24	1.24	1554.	0.036

Hyd	R/D Facility	Tributary	Reservoir	POC Outflow	
	Outflow	Inflow	Inflow	Target	Calc
1	0.70	0.18	*****	*****	0.86
2	0.23	0.09	*****	*****	0.29
3	0.18	0.10	*****	0.31	0.25
4	0.13	0.05	*****	*****	0.18
5	0.13	0.05	*****	*****	0.17
6	0.11	0.05	*****	0.19	0.15
7	0.07	0.04	*****	*****	0.11
8	0.06	0.03	*****	*****	0.08

Retention/Detention Facility

Type of Facility: East Detention Vault
 Facility Length: 45.00 ft
 Facility Width: 5.00 ft
 Facility Area: 225. sq. ft
 Effective Storage Depth: 4.80 ft
 Stage 0 Elevation: 0.00 ft
 Storage Volume: 1080. cu. ft
 Riser Head: 4.80 ft
 Riser Diameter: 12.00 inches
 Number of orifices: 2

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.00	0.059	
2	3.50	0.75	0.017	4.0

Top Notch Weir: None
 Outflow Rating Curve: None

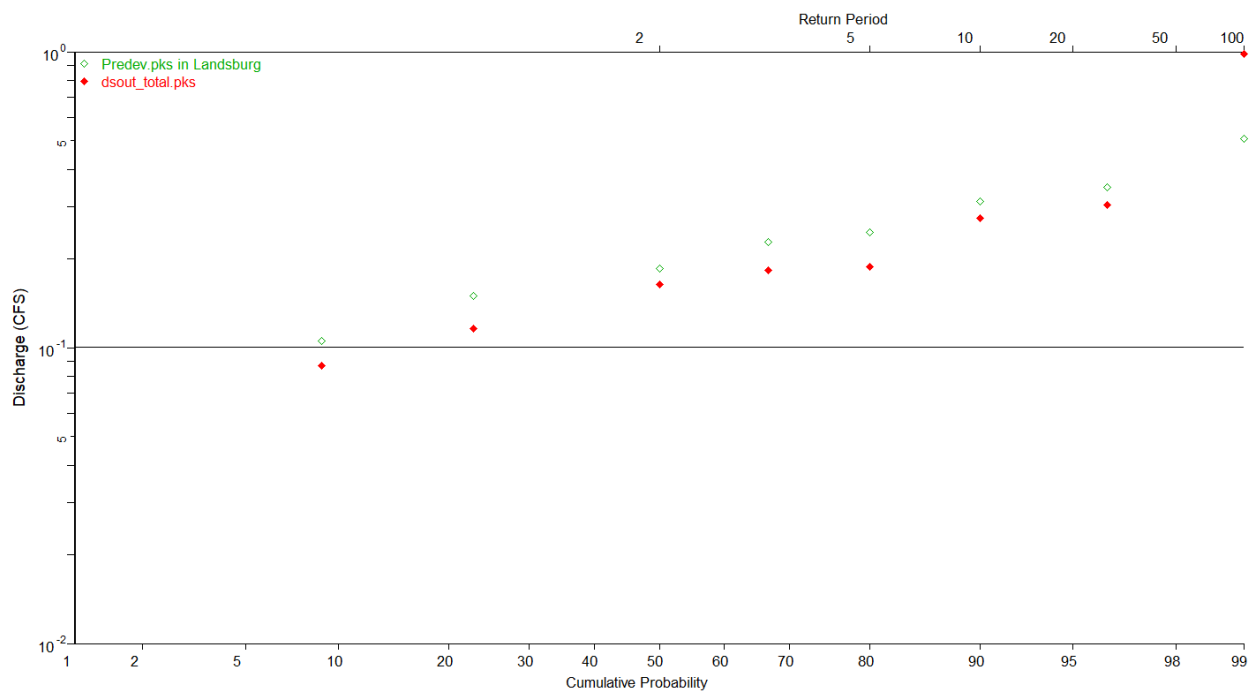
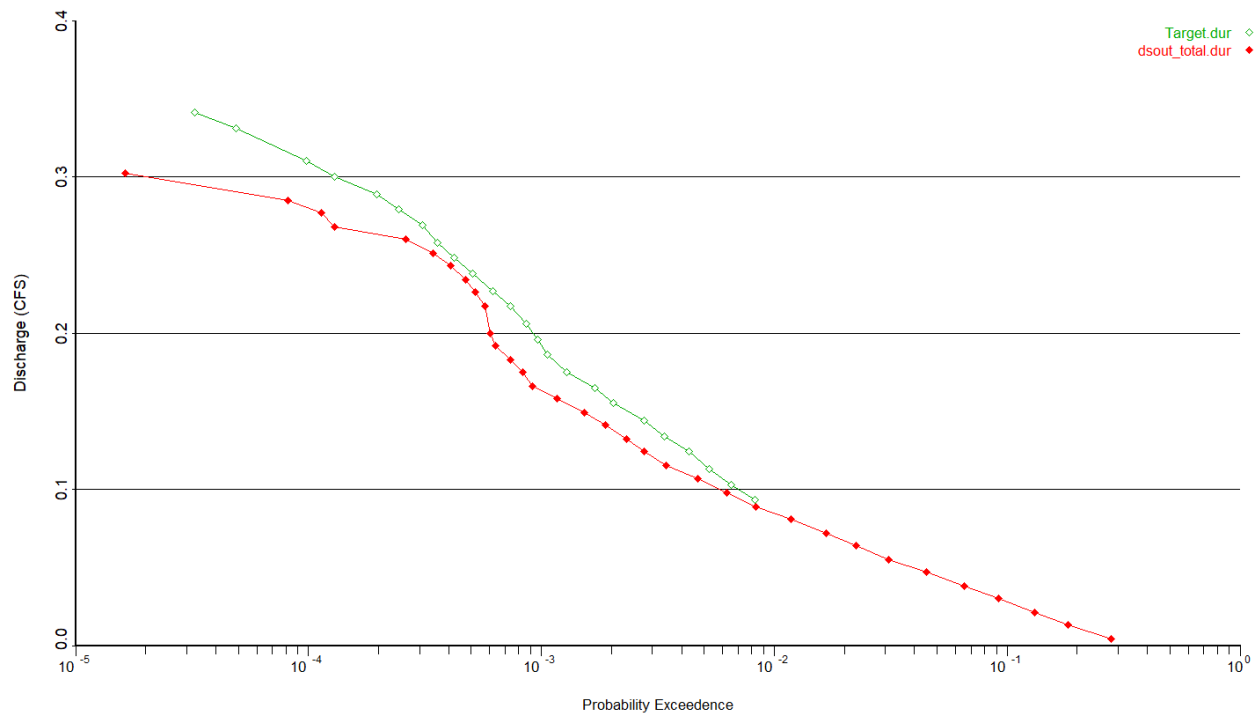
Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	2.	0.000	0.003	0.00
0.02	0.02	5.	0.000	0.004	0.00
0.03	0.03	7.	0.000	0.005	0.00
0.04	0.04	9.	0.000	0.006	0.00
0.05	0.05	11.	0.000	0.006	0.00
0.06	0.06	14.	0.000	0.007	0.00
0.07	0.07	16.	0.000	0.007	0.00
0.08	0.08	18.	0.000	0.008	0.00
0.09	0.09	20.	0.000	0.008	0.00
0.19	0.19	43.	0.001	0.012	0.00
0.29	0.29	65.	0.001	0.015	0.00
0.39	0.39	88.	0.002	0.017	0.00
0.49	0.49	110.	0.003	0.019	0.00
0.59	0.59	133.	0.003	0.021	0.00
0.69	0.69	155.	0.004	0.023	0.00
0.79	0.79	178.	0.004	0.024	0.00
0.89	0.89	200.	0.005	0.026	0.00
0.99	0.99	223.	0.005	0.027	0.00
1.09	1.09	245.	0.006	0.028	0.00
1.19	1.19	268.	0.006	0.030	0.00
1.29	1.29	290.	0.007	0.031	0.00
1.39	1.39	313.	0.007	0.032	0.00
1.49	1.49	335.	0.008	0.033	0.00
1.59	1.59	358.	0.008	0.034	0.00
1.69	1.69	380.	0.009	0.035	0.00
1.79	1.79	403.	0.009	0.036	0.00
1.89	1.89	425.	0.010	0.037	0.00
1.99	1.99	448.	0.010	0.038	0.00

2.09	2.09	470.	0.011	0.039	0.00
2.19	2.19	493.	0.011	0.040	0.00
2.29	2.29	515.	0.012	0.041	0.00
2.39	2.39	538.	0.012	0.042	0.00
2.49	2.49	560.	0.013	0.043	0.00
2.59	2.59	583.	0.013	0.044	0.00
2.69	2.69	605.	0.014	0.045	0.00
2.79	2.79	628.	0.014	0.045	0.00
2.89	2.89	650.	0.015	0.046	0.00
2.99	2.99	673.	0.015	0.047	0.00
3.09	3.09	695.	0.016	0.048	0.00
3.19	3.19	718.	0.016	0.048	0.00
3.29	3.29	740.	0.017	0.049	0.00
3.39	3.39	763.	0.018	0.050	0.00
3.49	3.49	785.	0.018	0.051	0.00
3.50	3.50	788.	0.018	0.051	0.00
3.51	3.51	790.	0.018	0.051	0.00
3.52	3.52	792.	0.018	0.052	0.00
3.53	3.53	794.	0.018	0.053	0.00
3.54	3.54	797.	0.018	0.054	0.00
3.55	3.55	799.	0.018	0.055	0.00
3.56	3.56	801.	0.018	0.055	0.00
3.66	3.66	824.	0.019	0.058	0.00
3.76	3.76	846.	0.019	0.060	0.00
3.86	3.86	869.	0.020	0.062	0.00
3.96	3.96	891.	0.020	0.064	0.00
4.06	4.06	914.	0.021	0.066	0.00
4.16	4.16	936.	0.021	0.068	0.00
4.26	4.26	959.	0.022	0.069	0.00
4.36	4.36	981.	0.023	0.071	0.00
4.46	4.46	1004.	0.023	0.072	0.00
4.56	4.56	1026.	0.024	0.074	0.00
4.66	4.66	1049.	0.024	0.075	0.00
4.76	4.76	1071.	0.025	0.076	0.00
4.80	4.80	1080.	0.025	0.077	0.00
4.90	4.90	1103.	0.025	0.386	0.00
5.00	5.00	1125.	0.026	0.950	0.00
5.10	5.10	1148.	0.026	1.680	0.00
5.20	5.20	1170.	0.027	2.470	0.00
5.30	5.30	1193.	0.027	2.760	0.00
5.40	5.40	1215.	0.028	3.010	0.00
5.50	5.50	1238.	0.028	3.250	0.00
5.60	5.60	1260.	0.029	3.470	0.00
5.70	5.70	1283.	0.029	3.680	0.00
5.80	5.80	1305.	0.030	3.870	0.00
5.90	5.90	1328.	0.030	4.060	0.00
6.00	6.00	1350.	0.031	4.230	0.00
6.10	6.10	1373.	0.032	4.400	0.00
6.20	6.20	1395.	0.032	4.570	0.00
6.30	6.30	1418.	0.033	4.730	0.00
6.40	6.40	1440.	0.033	4.880	0.00
6.50	6.50	1463.	0.034	5.030	0.00
6.60	6.60	1485.	0.034	5.170	0.00
6.70	6.70	1508.	0.035	5.310	0.00

6.80 6.80 1530. 0.035 5.450 0.00

Hyd	Inflow	Outflow	Peak		Storage	
			Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.16	0.16	4.83	4.83	1086.	0.025
2	0.12	0.07	4.24	4.24	955.	0.022
3	0.10	0.07	4.05	4.05	911.	0.021
4	0.11	0.05	3.42	3.42	770.	0.018
5	0.06	0.05	2.69	2.69	606.	0.014
6	0.07	0.04	2.20	2.20	496.	0.011
7	0.13	0.04	2.49	2.49	561.	0.013
8	0.05	0.03	1.48	1.48	332.	0.008

Hyd	R/D Facility	Tributary	Reservoir	POC Outflow	
	Outflow	Inflow	Inflow	Target	Calc
1	0.16	0.02	*****	*****	0.18
2	0.07	0.02	*****	*****	0.08
3	0.07	0.01	*****	0.03	0.08
4	0.05	0.02	*****	*****	0.06
5	0.05	0.01	*****	*****	0.05
6	0.04	0.01	*****	0.01	0.05
7	0.04	0.02	*****	*****	0.05
8	0.03	0.01	*****	*****	0.04



“Predev” is the target peak flows for the project site. Note that the total peak outflow of the detention facilities at the 2-year and 10-year event is less than that of the predeveloped condition, meeting the flow control requirement.